

```

> Thickness.A<-c(5,3,7,6,8,7,8,9,6,7,7,7,8,7,6,9,7,7,7,6,8,7,7,8,5,8,7,7,4,5,6,8)
> Thickness.B<-c(7,7,8,3,9,6,9,9,7,7,9,8,6,2,5,8,2,8,8,7,8,7,8,7,7,8,9,7,8,4,8,9)
> Thickness.C<-c(6,5,7,6,5,7,8,7,6,6,9,3,7,3,6,9,5,7,7,5,6,7,3,6,6,8,6,7,5,3,7,9)
> Thickness.D<-c(7,6,8,4,6,6,8,4,7,4,8,8,7,4,5,9,3,4,8,5,3,8,8,6,6,5,7,7,6,5,5,8)
> Thickness.E<-c(6,4,6,5,5,5,8,7,3,4,3,2,4,1,5,9,7,4,5,5,3,3,3,4,3,7,7,4,4,7,5,6)
> Thickness.F<-c(3,4,6,5,7,5,9,3,4,4,4,7,6,7,2,9,8,3,6,6,4,8,6,4,3,4,8,6,3,3,4,6)
> Thickness.G<-c(6,7,4,8,6,6,8,1,3,4,5,4,5,1,5,8,2,1,4,2,4,6,9,7,3,4,6,4,4,6,2,3)
> Thickness.H<-c(6,7,8,6,5,5,8,2,4,3,5,8,5,5,7,7,8,2,8,3,3,5,5,5,3,6,8,6,3,4,4,6)
> Thickness.I<-c(8,1,7,5,8,4,8,9,6,5,9,4,7,6,6,9,7,4,7,7,8,6,9,8,7,7,6,8,7,4,7,9)
> Thickness.J<-c(7,3,8,7,7,7,9,9,6,6,8,6,7,3,6,9,6,9,8,7,6,7,8,7,6,8,7,7,5,6,8,9)
> Thickness.K<-c(7,4,7,7,7,7,8,9,6,4,8,8,6,6,8,3,6,3,5,5,5,9,8,4,4,7,6,6,4,5,8)
> Thickness.L<-c(8,4,8,7,7,6,7,7,4,8,6,7,4,5,8,9,7,7,7,5,5,7,4,7,6,8,8,4,7,7,8)
> Thickness.M<-c(2,4,5,5,5,7,1,3,3,3,6,5,1,4,9,7,2,3,6,4,2,9,4,3,6,7,5,2,6,4,4)
> Thickness.N<-c(2,8,7,9,7,5,8,4,5,6,6,3,7,2,3,9,8,7,7,6,5,8,6,6,3,7,9,4,5,7,4,8)
> Thickness.O<-c(6,8,8,4,5,5,8,4,4,5,5,6,4,5,6,9,6,5,4,4,5,4,7,4,3,8,7,4,3,6,3,7)
> Thickness.P<-c(4,2,5,9,5,5,8,1,4,4,3,2,5,1,6,7,8,2,6,5,3,5,9,4,2,6,6,4,3,6,4,2)
>flavour<-c(Thickness.A,Thickness.B,Thickness.C,Thickness.D,Thickness.E,Thickness.F,Thickness.G,
Thickness.H,Thickness.I,Thickness.J,Thickness.K,Thickness.L,Thickness.M,Thickness.N,Thickness.O,
Thickness.P)
> samples.A<-rep("A",times=32)
> samples.B<-rep("B",times=32)
> samples.C<-rep("C",times=32)
> samples.D<-rep("D",times=32)
> samples.E<-rep("E",times=32)
> samples.F<-rep("F",times=32)
> samples.G<-rep("G",times=32)
> samples.H<-rep("H",times=32)
> samples.I<-rep("I",times=32)
> samples.J<-rep("J",times=32)
> samples.K<-rep("K",times=32)
> samples.L<-rep("L",times=32)
> samples.M<-rep("M",times=32)
> samples.N<-rep("N",times=32)
> samples.O<-rep("O",times=32)
> samples.P<-rep("P",times=32)
>samples<-factor( c(samples.A,samples.B,samples.C,samples.D,samples.E,samples.F,samples.G,sa
mples.H,samples.I,samples.J,samples.K,samples.L,samples.M,samples.N,samples.O,samples.P))
> assessors<-factor(rep(c(1:32),times=16))
> results<-data.frame(samples=factor(samples),assessors=factor(assessors),flavour=flavour)
> results

```

	samples	assessors	flavour
1	A	1	5
2	A	2	3
3	A	3	7

4	A	4	6
5	A	5	8
6	A	6	7
7	A	7	8
8	A	8	9
9	A	9	6
10	A	10	7
11	A	11	7
12	A	12	7
13	A	13	8
14	A	14	7
15	A	15	6
16	A	16	9
17	A	17	7
18	A	18	7
19	A	19	7
20	A	20	6
21	A	21	8
22	A	22	7
23	A	23	7
24	A	24	8
25	A	25	5
26	A	26	8
27	A	27	7
28	A	28	7
29	A	29	4
30	A	30	5
31	A	31	6
32	A	32	8
33	B	1	7
34	B	2	7
35	B	3	8
36	B	4	3
37	B	5	9
38	B	6	6
39	B	7	9
40	B	8	9
41	B	9	7
42	B	10	7
43	B	11	9
44	B	12	8
45	B	13	6
46	B	14	2
47	B	15	5

48	B	16	8
49	B	17	2
50	B	18	8
51	B	19	8
52	B	20	7
53	B	21	8
54	B	22	7
55	B	23	8
56	B	24	7
57	B	25	7
58	B	26	8
59	B	27	9
60	B	28	7
61	B	29	8
62	B	30	4
63	B	31	8
64	B	32	9
65	C	1	6
66	C	2	5
67	C	3	7
68	C	4	6
69	C	5	5
70	C	6	7
71	C	7	8
72	C	8	7
73	C	9	6
74	C	10	6
75	C	11	9
76	C	12	3
77	C	13	7
78	C	14	3
79	C	15	6
80	C	16	9
81	C	17	5
82	C	18	7
83	C	19	7
84	C	20	5
85	C	21	6
86	C	22	7
87	C	23	3
88	C	24	6
89	C	25	6
90	C	26	8
91	C	27	6

92	C	28	7
93	C	29	5
94	C	30	3
95	C	31	7
96	C	32	9
97	D	1	7
98	D	2	6
99	D	3	8
100	D	4	4
101	D	5	6
102	D	6	6
103	D	7	8
104	D	8	4
105	D	9	7
106	D	10	4
107	D	11	8
108	D	12	8
109	D	13	7
110	D	14	4
111	D	15	5
112	D	16	9
113	D	17	3
114	D	18	4
115	D	19	8
116	D	20	5
117	D	21	3
118	D	22	8
119	D	23	8
120	D	24	6
121	D	25	6
122	D	26	5
123	D	27	7
124	D	28	7
125	D	29	6
126	D	30	5
127	D	31	5
128	D	32	8
129	E	1	6
130	E	2	4
131	E	3	6
132	E	4	5
133	E	5	5
134	E	6	5
135	E	7	8

136	E	8	7
137	E	9	3
138	E	10	4
139	E	11	3
140	E	12	2
141	E	13	4
142	E	14	1
143	E	15	5
144	E	16	9
145	E	17	7
146	E	18	4
147	E	19	5
148	E	20	5
149	E	21	3
150	E	22	3
151	E	23	3
152	E	24	4
153	E	25	3
154	E	26	7
155	E	27	7
156	E	28	4
157	E	29	4
158	E	30	7
159	E	31	5
160	E	32	6
161	F	1	3
162	F	2	4
163	F	3	6
164	F	4	5
165	F	5	7
166	F	6	5
167	F	7	9
168	F	8	3
169	F	9	4
170	F	10	4
171	F	11	4
172	F	12	7
173	F	13	6
174	F	14	7
175	F	15	2
176	F	16	9
177	F	17	8
178	F	18	3
179	F	19	6

180	F	20	6
181	F	21	4
182	F	22	8
183	F	23	6
184	F	24	4
185	F	25	3
186	F	26	4
187	F	27	8
188	F	28	6
189	F	29	3
190	F	30	3
191	F	31	4
192	F	32	6
193	G	1	6
194	G	2	7
195	G	3	4
196	G	4	8
197	G	5	6
198	G	6	6
199	G	7	8
200	G	8	1
201	G	9	3
202	G	10	4
203	G	11	5
204	G	12	4
205	G	13	5
206	G	14	1
207	G	15	5
208	G	16	8
209	G	17	2
210	G	18	1
211	G	19	4
212	G	20	2
213	G	21	4
214	G	22	6
215	G	23	9
216	G	24	7
217	G	25	3
218	G	26	4
219	G	27	6
220	G	28	4
221	G	29	4
222	G	30	6
223	G	31	2

224	G	32	3
225	H	1	6
226	H	2	7
227	H	3	8
228	H	4	6
229	H	5	5
230	H	6	5
231	H	7	8
232	H	8	2
233	H	9	4
234	H	10	3
235	H	11	5
236	H	12	8
237	H	13	5
238	H	14	5
239	H	15	7
240	H	16	7
241	H	17	8
242	H	18	2
243	H	19	8
244	H	20	3
245	H	21	3
246	H	22	5
247	H	23	5
248	H	24	5
249	H	25	3
250	H	26	6
251	H	27	8
252	H	28	6
253	H	29	3
254	H	30	4
255	H	31	4
256	H	32	6
257	I	1	8
258	I	2	1
259	I	3	7
260	I	4	5
261	I	5	8
262	I	6	4
263	I	7	8
264	I	8	9
265	I	9	6
266	I	10	5
267	I	11	9

268	I	12	4
269	I	13	7
270	I	14	6
271	I	15	6
272	I	16	9
273	I	17	7
274	I	18	4
275	I	19	7
276	I	20	7
277	I	21	8
278	I	22	6
279	I	23	9
280	I	24	8
281	I	25	7
282	I	26	7
283	I	27	6
284	I	28	8
285	I	29	7
286	I	30	4
287	I	31	7
288	I	32	9
289	J	1	7
290	J	2	3
291	J	3	8
292	J	4	7
293	J	5	7
294	J	6	7
295	J	7	9
296	J	8	9
297	J	9	6
298	J	10	6
299	J	11	8
300	J	12	6
301	J	13	7
302	J	14	3
303	J	15	6
304	J	16	9
305	J	17	6
306	J	18	9
307	J	19	8
308	J	20	7
309	J	21	6
310	J	22	7
311	J	23	8

312	J	24	7
313	J	25	6
314	J	26	8
315	J	27	7
316	J	28	7
317	J	29	5
318	J	30	6
319	J	31	8
320	J	32	9
321	K	1	7
322	K	2	4
323	K	3	7
324	K	4	7
325	K	5	7
326	K	6	7
327	K	7	8
328	K	8	9
329	K	9	6
330	K	10	4
331	K	11	8
332	K	12	8
333	K	13	8
334	K	14	6
335	K	15	6
336	K	16	8
337	K	17	3
338	K	18	6
339	K	19	3
340	K	20	5
341	K	21	5
342	K	22	5
343	K	23	9
344	K	24	8
345	K	25	4
346	K	26	4
347	K	27	7
348	K	28	6
349	K	29	6
350	K	30	4
351	K	31	5
352	K	32	8
353	L	1	8
354	L	2	4
355	L	3	8

356	L	4	7
357	L	5	7
358	L	6	6
359	L	7	7
360	L	8	7
361	L	9	7
362	L	10	4
363	L	11	8
364	L	12	6
365	L	13	7
366	L	14	4
367	L	15	5
368	L	16	8
369	L	17	9
370	L	18	7
371	L	19	7
372	L	20	7
373	L	21	5
374	L	22	5
375	L	23	7
376	L	24	4
377	L	25	7
378	L	26	6
379	L	27	8
380	L	28	8
381	L	29	4
382	L	30	7
383	L	31	7
384	L	32	8
385	M	1	2
386	M	2	4
387	M	3	5
388	M	4	5
389	M	5	5
390	M	6	5
391	M	7	7
392	M	8	1
393	M	9	3
394	M	10	3
395	M	11	3
396	M	12	6
397	M	13	5
398	M	14	1
399	M	15	4

400	M	16	9
401	M	17	7
402	M	18	2
403	M	19	3
404	M	20	6
405	M	21	4
406	M	22	2
407	M	23	9
408	M	24	4
409	M	25	3
410	M	26	6
411	M	27	7
412	M	28	5
413	M	29	2
414	M	30	6
415	M	31	4
416	M	32	4
417	N	1	2
418	N	2	8
419	N	3	7
420	N	4	9
421	N	5	7
422	N	6	5
423	N	7	8
424	N	8	4
425	N	9	5
426	N	10	6
427	N	11	6
428	N	12	3
429	N	13	7
430	N	14	2
431	N	15	3
432	N	16	9
433	N	17	8
434	N	18	7
435	N	19	7
436	N	20	6
437	N	21	5
438	N	22	8
439	N	23	6
440	N	24	6
441	N	25	3
442	N	26	7
443	N	27	9

444	N	28	4
445	N	29	5
446	N	30	7
447	N	31	4
448	N	32	8
449	O	1	6
450	O	2	8
451	O	3	8
452	O	4	4
453	O	5	5
454	O	6	5
455	O	7	8
456	O	8	4
457	O	9	4
458	O	10	5
459	O	11	5
460	O	12	6
461	O	13	4
462	O	14	5
463	O	15	6
464	O	16	9
465	O	17	6
466	O	18	5
467	O	19	4
468	O	20	4
469	O	21	5
470	O	22	4
471	O	23	7
472	O	24	4
473	O	25	3
474	O	26	8
475	O	27	7
476	O	28	4
477	O	29	3
478	O	30	6
479	O	31	3
480	O	32	7
481	P	1	4
482	P	2	2
483	P	3	5
484	P	4	9
485	P	5	5
486	P	6	5
487	P	7	8

488	P	8	1
489	P	9	4
490	P	10	4
491	P	11	3
492	P	12	2
493	P	13	5
494	P	14	1
495	P	15	6
496	P	16	7
497	P	17	8
498	P	18	2
499	P	19	6
500	P	20	5
501	P	21	3
502	P	22	5
503	P	23	9
504	P	24	4
505	P	25	2
506	P	26	6
507	P	27	6
508	P	28	4
509	P	29	3
510	P	30	6
511	P	31	4
512	P	32	2

```
> library(asbio)
```

```
> tukey.add.test(results$flavour,results$samples,results$assessors)
```

Tukey's one df test for additivity

data: results\$samples and results\$assessors on results\$flavour
F = 7.2837, num.df = 1, denom.df = 464, p-value = 0.007212

```
> preference.aov<-aov(flavour~samples+assessors,results)
```

```
> summary(preference.aov)
```

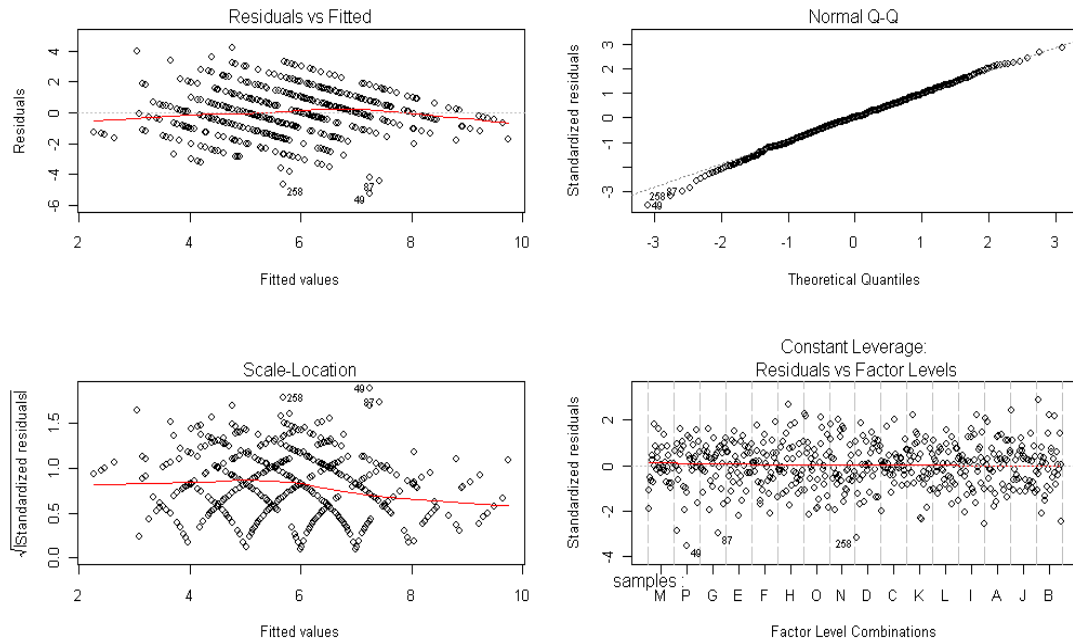
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
samples	15	381.80	25.4536	10.6086	< 2.2e-16 ***
assessors	31	532.55	17.1792	7.1599	< 2.2e-16 ***
Residuals	465	1115.70	2.3993		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```
> oldpar<-par(oma=c(0,0,3,0),mfrow=c(2,2))
```

```
> plot(preference.aov)
```

```
aov(flavour ~ samples + assessors)
```



> Thickness<-

```
matrix(c(5,3,7,6,8,7,8,9,6,7,7,7,8,7,6,9,7,7,7,6,8,7,7,8,5,8,7,7,4,5,6,8,7,7,8,3,9,6,9,9,7,7,9,8,6,2,5,
8,2,8,8,7,8,7,8,7,7,8,9,7,8,4,8,9,6,5,7,6,5,7,8,7,6,6,9,3,7,3,6,9,5,7,7,5,6,7,3,6,6,8,6,7,5,3,7,9,7,6,8,
4,6,6,8,4,7,4,8,8,7,4,5,9,3,4,8,5,3,8,8,6,6,5,7,7,6,5,5,8,6,4,6,5,5,5,8,7,3,4,3,2,4,1,5,9,7,4,5,5,3,3,3,
4,3,7,7,4,4,7,5,6,3,4,6,5,7,5,9,3,4,4,4,7,6,7,2,9,8,3,6,6,4,8,6,4,3,4,8,6,3,3,4,6,6,7,4,8,6,6,8,1,3,4,5,
4,5,1,5,8,2,1,4,2,4,6,9,7,3,4,6,4,4,6,2,3,6,7,8,6,5,5,8,2,4,3,5,8,5,5,7,7,8,2,8,3,3,5,5,5,3,6,8,6,3,4,4,
6,8,1,7,5,8,4,8,9,6,5,9,4,7,6,6,9,7,4,7,7,8,6,9,8,7,7,6,8,7,4,7,9,7,3,8,7,7,9,9,6,6,8,6,7,3,6,9,6,9,8,
7,6,7,8,7,6,8,7,7,5,6,8,9,7,4,7,7,7,7,8,9,6,4,8,8,8,6,6,8,3,6,3,5,5,5,9,8,4,4,7,6,6,4,5,8,8,4,8,7,7,6,7,
7,7,4,8,6,7,4,5,8,9,7,7,7,5,5,7,4,7,6,8,8,4,7,7,8,2,4,5,5,5,5,7,1,3,3,3,6,5,1,4,9,7,2,3,6,4,2,9,4,3,6,7,
5,2,6,4,4,2,8,7,9,7,5,8,4,5,6,6,3,7,2,3,9,8,7,7,6,5,8,6,6,3,7,9,4,5,7,4,8,6,8,8,4,5,5,8,4,4,5,5,6,4,5,6,
9,6,5,4,4,5,4,7,4,3,8,7,4,3,6,3,7,4,2,5,9,5,5,8,1,4,4,3,2,5,1,6,7,8,2,6,5,3,5,9,4,2,6,6,4,3,6,4,2),nrow
= 32,byrow = FALSE,dimnames = list(1 : 32, c("A", "B",
"C","D","E","F","G","H","I","J","K","L","M","N","O","P"))))
```

```
> result <-friedman.test(Thickness)
```

```
> result
```

Friedman rank sum test

data: Thickness

Friedman chi-squared = 128.0191, df = 15, p-value < 2.2e-16